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(54) **Printing on pharmaceutical mouldings, tablets or coated tablets**

(57) A method of applying an identifying mark to a moulded pharmaceutical or foodstuff, which comprises printing the moulded pharmaceutical or foodstuff with a non-toxic colouring ink thereby to form a mark thereon, wherein the ink is applied to the moulded pharmaceutical or foodstuff by an ink-jet printer.

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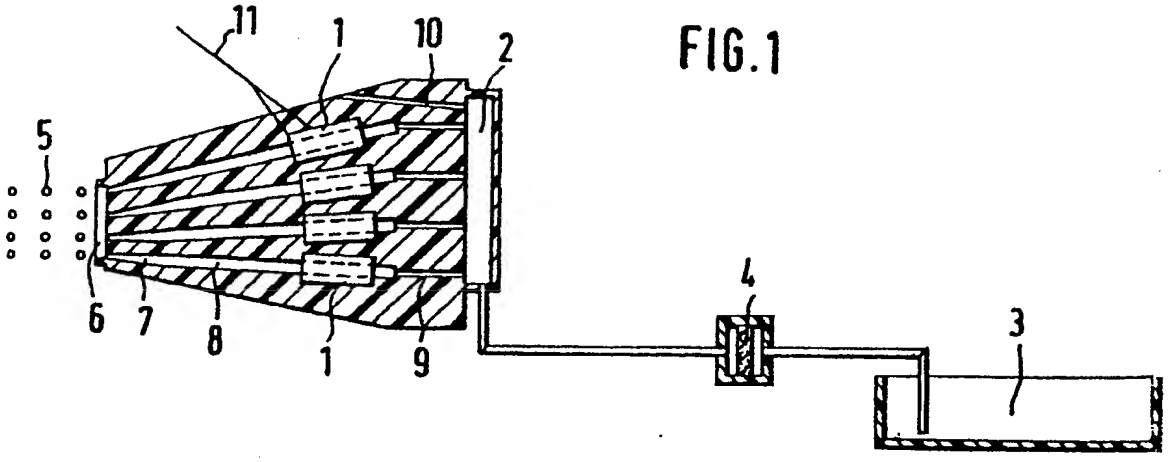


FIG.1

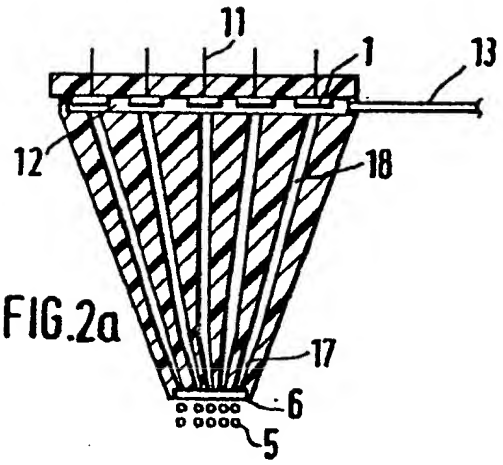


FIG.2a

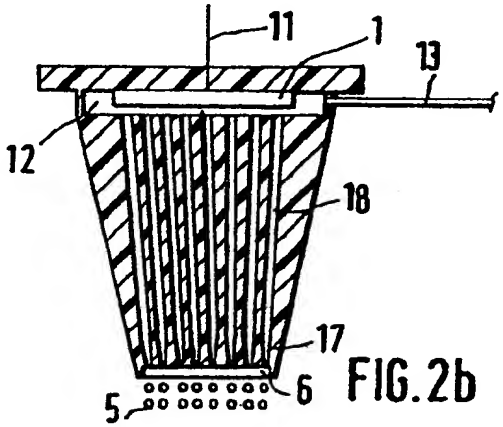


FIG.2b

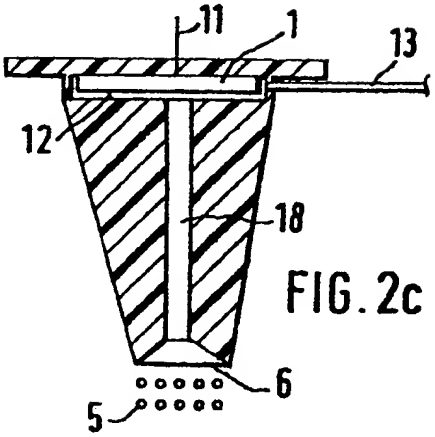
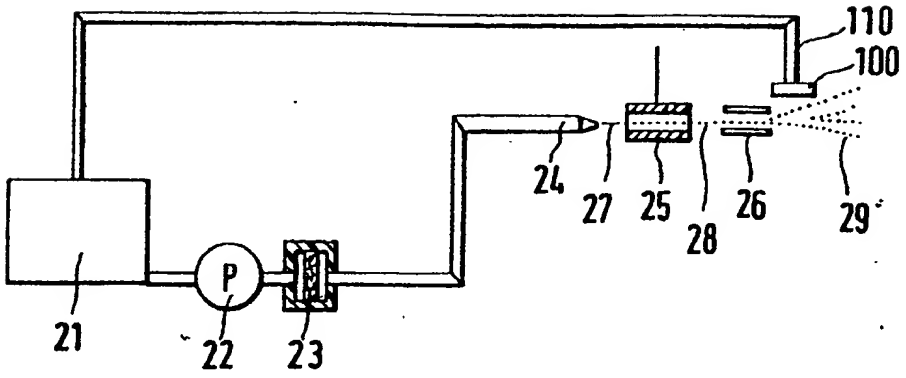


FIG.2c

FIG.3



SPECIFICATION

Application of an ink-jet printer for the non-contact lettering or printing of pharmaceutical mouldings or of tablets or coated tablets in the field of foodstuffs

The invention is concerned with the application of an ink-jet printer for the non-contact lettering or printing of pharmaceutical mouldings or of tablets or coated tablets in the field of foodstuffs. Pharmaceutical mouldings may be e.g. tablets, coated tablets, capsules or suppositories.

It may be appropriate to cause to appear certain markings (e.g. a bisecting strip, a warning note or a symbol related to use, for example with sleeping agents a bed or with vitamin tablets a fruit) not only on packing or encasing, but also on the pharmaceutical moulding itself. However, this is not simple both due to the smallness and owing to the frequently non-planar surface of such mouldings and also the nature of the surface presents often unsurmountable difficulties to normal printing (e.g. by the roller rotation method). It has therefore been conventional hitherto with tablets to effect the lettering by means of engravings in the press tools during the pressing operation itself. It is necessary, in so doing, to provide for each preparation a special pressing tool, e.g. punch, provided with appropriate engravings; this increases the cost of the manufacture of the mouldings to a large extent, especially as e.g. an engraved punch is substantially more expensive than a non-engraved punch. In addition, such an embossing is not easily legible in particular light conditions and, in this respect, makes special demands on the observer, but also on the quality of the granulate.

It has now been found that mouldings of the widest diversity of size, type and nature of the surface can be lettered or printed easily due to the fact that the lettering or printing is effected in a non-contact manner with the use of a so-called "ink-jet printer" filled with a foodstuff colour solution or suspension. In so doing, the colour solution or suspension is dotted onto the moulding in the form of discrete droplets of equal volume so that due to deliberate guidance and deflection of the droplets letter symbols or other signs such as illustrations or markings (so-called codes) are obtained on a part of the surface of the moulding. A symbol applied in this way is more easily visible and with pharmaceutical forms of application it helps to safeguard the patient against confusion when taking his medicines. Pharmaceuticals identified in this way not only represent a contribution to achieving a maximum degree of pharmaceutical safety, but also improve the patient's taking habits. If the pharmaceutical forms such as tablets, coated tablets or capsules are lettered e.g. before the sealing on a blister machine with the taking date and taking time, then a regular taking necessary for the cure may be expected.

By an ink-jet printer used within the scope of the invention is meant hereinafter a printing device developed per se for high-speed printing on paper by means of a computer-controlled writing stations (so-called terminals). A distinction is made between high-pressure, low-pressure and vacuum processes, depending on the pressure with which the colour solution or suspension to be sprayed is supplied to the nozzles of the device.

In the low-pressure process the colour solution or suspension wets the end side of a nozzle, thus forming a convex meniscus. Upon the application of an electrical field there are drawn away from this colour meniscus droplets which can be deflected electrostatically for the printing or lettering of mouldings.

In the high-pressure process the colour solution or suspension emerges as a jet from a narrow nozzle. Immediately after leaving the nozzle the colour solution or suspension disintegrates into individual droplets of equal volume which are deflectable electrostatically or magnetically. The liquid is supplied to the nozzle under pressure by means of a pump. Regular contractions in the liquid jet may also be obtained with or without pressure due to ultrasonic stimulation and consequently a decomposition into uniform droplets. As shown in Figure 3, the fine, uniformly large droplets are charged by a charging electrode; the electrically charged droplets are deflected electrostatically or electromagnetically to the desired points of the mouldings.

Since it is not possible to call up individual droplets, unused droplets are drawn off by means of a suction electrode and the liquid or suspension is guided back into the supply container. Despite this disadvantage excellent print or letter images are produced with the above-described system, since the generated droplets preferably have a small diameter of about 20 μm.

Another advantageous form of realisation for the lettering or printing of mouldings utilises the so-called vacuum process. The system consists e.g. of one or an entire series, 12 or 24, of channels so that a tubular piezoelectric oscillator surrounds concentrically a section of each channel. There serve as electrodes for the application of the electrical field conductive layers, e.g. silver layers, on the faces of the tubular piezoelectric oscillator. The individual channels are connected on their outlet side e.g. to a common distributor plate connected to a supply container and are supplied therefrom with the colour solution or suspension (see Figure 1).

The flowback of the liquid or suspension in the nozzle channel is obstructed e.g. due to the fact that the nozzle channel is narrowed towards the outlet opening. Due to the property of piezoelectric oscillators, e.g. of piezoceramic masses, to undergo an elastic deformation upon the application of a specific electrical field, a shock wave directed to the liquid arises in the tubular piezoelectric oscillators. The pressure increase connected therewith leads to the shooting of very small quantities of colour in lobe form out of the outlet openings, these lobes of liquid assuming a spherical form after leaving the outlet openings.

The diameter of a channel is advantageously about 1 mm in its middle part and the individual channel is narrowed at its outlet opening. The diameter of the outlet opening is e.g. 0.1 mm.

The supply container lies lower than the outlet openings and a vacuum system is therefore referred to. Due to the height difference a static vacuum arises in the channels. This static vacuum is overcompensated for a short moment in the channels upon the application of the electrical field in conjunction with the capillary action. One exemplary embodiment of this printing system contains twelve nozzle openings, namely six each in two offset rows. The spacing of the nozzle plate from the mouldings may be up to 20 mm; it preferably lies at 1 to 3 mm. The diameter of the droplets lies e.g. at 0.1 mm.

Another advantageous form of realisation for the lettering or printing of mouldings consists in the use of plate-shaped or planar transducers which work on the piezoelectric principle and which are preferably attached in a distributor chamber concentrically over the entrance of the channels; narrowed outlet openings are again situated at the end of the channels. In a preferred form of realisation the piezoelectric plate lies in a distributor chamber horizontally concentrically to the channel leading away vertically. The piezoelectric plates lie in or on this chamber to receive the colour solution or suspension. Also, several channels may lead away from a common chamber which is connected, in turn, to a common liquid supply. Thus, e.g. also a planar oscillator (piezoelectric plate) can generate simultaneously a pressure wave in several channels adjoining the same distributor chamber.

A further advantageous and structurally simplified form of realisation contains a planar oscillator of strong stroke in the chamber and a channel which departs from the chamber and at the end of which are situated several nozzles. Due to such an arrangement a surface dotting of the mouldings may be achieved with a single stroke generated by the piezoelectric oscillator (see Figure 2a, b, c).

The printing system preferably used works with tubular or plate-shaped piezoelectric oscillators. Upon the application of a voltage pulse of e.g. 100 volts and a pulse length of 20 microseconds, droplets are ejected at a speed of about 4 m/sec and with a very constant droplet weight of e.g. 0.8 μm (0.0008 mg). Depending on the electronic control, the drop frequency may lie between 1 and 50,000 drops per second, preferably at 3,000 drops per second.

The symbol or the lettering to be applied is first set in the writing station of the printing system. The printing electronics for the control of the individual nozzles are situated generally on a circuit board which may contain, besides power amplifiers for the piezoelectric transducers, also a circuit for monitoring the printing liquid.

Upon the printing either the printing head is guided over the mouldings or the mouldings are guided passed the fixed printing head. The printing system works so precisely and quickly that e.g. the mouldings can be printed at several metres per second, but preferably at about 1 m/sec.

Thus, e.g. tablets, coated tablets or capsules are separated, that is delivered in a row to a conveyor belt which moves past under the nozzle openings of the printing mechanism. In so doing, the mouldings are scanned e.g. by a photocell, so that the printing can be started exactly at the right moment in order to apply it precisely at the point of the moulding provided. In this way, it is even possible to print extremely concave or convex mouldings.

The printing operation proceeding in a non-contact manner is best effected in the manufacture of tablets or coated-tablet cores if the moulding just pressed in the tabletting machine is pushed up out of the cavity by the bottom force, that is immediately before it is picked up by the so-called scraper. The printing operation, namely the ejection of the colour droplets out of the individual nozzles at the correct moment, is controlled by the writing station. For this purpose, the running speed of the tablet press must constantly be transmitted exactly to the electronics of the writing station e.g. by means of a photocell or a magnetic proximity switch. This is effected by devices known per se.

If work is carried out according to Figure 2c with a printing head which consists of a planar oscillator of strong stroke and a liquid channel at the end of which is situated a nozzle template, then the electronics for the printing operation can be substantially simplified. If e.g. the tablet is detected by a photocell, the printing-on of a symbol or the lettering with a code is effected due to a single stroke of the planar oscillator. This operation may be concluded much more rapidly than in one millisecond, that is the printing device adapts itself easily to any tabletting speed. Furthermore, the favourable overall height of the printing head is to be emphasised. It may be less than 2 cm high and can thus be accommodated without difficulty on any known tabletting machine.

Of course, the system of planar oscillator with nozzle template according to Figure 2c is also applicable at any other point such as e.g. on separating apparatus for tablets, coated tablets, capsules and suppositories, on a capsule filling machine or in coated-tablet printing machines instead of the printing device working with contact, as conventional hitherto.

Altogether, the complete independence of the printing or lettering from the surface of the mouldings is to be emphasised in the process according to the invention. It is unimportant whether the surface is rough or corrugated or if the moulding has extremely concave or convex forms. According to the state of the art, in the printing of pharmaceutical forms only a small sector of the surface can be printed with contact due to the convex form e.g. of coated tablets and capsules. With the process according to the invention e.g. the entire curved surface of a coated

tablet can be printed independently of the radius or curvature. Since the operation proceeds in a non-contact manner, a lubrication, as occurs frequently in the conventional processes, is not possible.

The colour solutions or suspensions employed by means of the above-described devices are appropriately prepared by means of a wetting hygroscopic solvent or suspension agent, e.g. with alcohols or a mixture of lower aliphatic alcohols with water and/or polyols such as glycol or glycerol. For a better fixing on the surfaces, adhesives such as methyl cellulose, hydroxypropyl methyl cellulose or hydroxypropyl methyl cellulose phthalate are to be recommended.

Finally, the above-described system of the non-contact printing or lettering of mouldings can be used preeminently for the in-house checking of incorrect mixtures and intermixes. If e.g. an active substance is pressed into tablets in two different doses, the tablet with the smaller dose can be provided e.g. on the tablet press with one colour spot and that with a higher dose with two colour spots. These may be visible coloured spots or invisible coding spots fluorescent e.g. in ultra-violet light. Finally, if e.g. all tablets are provided with a coding by means of the process according to the invention and if detectors responding to the coding are fitted to the packing machines, then e.g. a 100% control of an incorrect mix, if any, is possible.

The process according to the invention works substantially more quickly and more precisely than conventional printing methods; 100 moulding per second or more can be printed. The process also works more carefully and is universally applicable, that is to solid pharmaceutical forms of all kinds or analogously produced foodstuff forms. The safety of application of such pharmaceutical forms is increased if e.g. with the same active substance in different doses clearly visible special codings are printed on the moulding to minimise confusion or if the pharmaceutical form is lettered with the specification of the quantity of active substance. With coloured coated tablets the quantity of colour can be drastically reduced by coating the tablets white and coding them only with one coloured symbol. Correspondingly, with film tablets the colour-coded tablets are covered with a colourless transparent lacquer.

The following Examples illustrate the invention without limiting its scope.

EXAMPLE 1

10,00 multi-vitamin coated tablets with a conventional sugar case are laid in a row on a high-speed conveyor belt provided with a corresponding groove. The symbol of an orange is sprayed onto them by means of a printing system which works according to the vacuum process and a piezoelectrically generated shockwave and which is filled with an edible orange solution in isopropanol (with a small addition of glycerol). The passing coated tablets are scanned by means of a photocell and the timing of the spraying operation is adjusted correspondingly.

EXAMPLE 2

At a tabletting speed of 100,000 tablets per hour 8-mm mouldings are printed immediately before the scraper with a printing device consisting of a planar oscillator and a nozzle template. The printing operation is started by means of a photocell. The printing suspension consists of micronised iron oxide in glycol. The code 38C/38C consists of a 150 droplets with a droplet weight of about 0.0006 mg. The quantity of colour per tablet is about $9\gamma = 0.009$ mg. The excitation of the planar oscillator is concluded after 0.3 milliseconds.

EXAMPLE 3

In separating apparatus 9-mm tablets are placed upright and printed on the front and rear sides. The two printing heads working according to the vacuum system each consist of 12 nozzles. The preparation name (10 letters) is printed on the front side and the dose (50 mg) is printed on the rear side. The colour solution is a saturated aqueous yellow orange solution.

The feed speed is 1 m/sec. 150,000 tablets per hour are printed. The droplet frequency for the vacuum system is 3,000 droplets per second.

EXAMPLE 4

A fleece of cellulose doped with active substance and unwinding from a coil at a uniform speed is printed by the high-pressure process with the preparation name, taking date and quantity of active substance. The writing speed is 90 characters per second. The colour solution consists of indigo blue dissolved in water/glycerol.

Figures 1 to 3 describe by way of example advantageous systems for the non-contact printing of pharmaceutical mouldings or of tablets or coated tablets in the field of foodstuffs.

Figure 1 shows schematically in cross section a dotting system with piezoelectric transducers (1) which each surround a nozzle channel (8); the nozzle channel terminates in a narrowing (7), the individual narrowings (7) occurring at corresponding openings of an outlet nozzle plate (6). The nozzles formed by the narrowing (7) and the openings of the outlet plate (6) deliver liquid droplets (5) upon actuation of the device. The nozzle channel (8) is connected to a liquid chamber (2) via a narrowed liquid channel (9). The chamber (2) serving as distributor has a venting channel (10). The distributor chamber (2) is connected via a filter plate (4) to a liquid supply container (3). The electrical selection of the piezoelectric transducers is effected via contacts (11).

Figures 2a, 2b and 2c show cross sections through variously designed dotting heads with planar transducers working on the piezoelectric principle. (1) denotes a planar piezoelectric transducer with contacts (11) for electrical selection. The planar transducer lies in a liquid chamber (12) which is connected via the liquid

line (13) to a supply container. One or more nozzle channels (18) whose narrowings (17) terminate at an outlet nozzle plate (6) depart from the chamber (12); the released liquid droplets are designated by (5).

Figure 3 describes schematically a cross section through a so-called high-pressure dotting system. Ink is pressed into the nozzle (24) from a liquid supply container (21) through a filter (23) by means of a pump (22). The ink jet (27) released at the nozzle (24) disintegrates into drops (28) which are electrically charged by a drop charging ring (25) and are deflected by means of a deflector plate (26) in an electrical field. The liquid drop (29) thus deflected letters the mouldings. The remaining drops (29) are drawn by a suction electrode (100) and collected and are returned to the container (21) via the line (110). The ink is electrically chargeable due to suitable additions.

CLAIMS

1. A method of applying an identifying mark to a moulded pharmaceutical or foodstuff, which comprises printing the moulded pharmaceutical or foodstuff with a non-toxic colouring ink thereby to form a mark thereon, wherein the ink is applied to the moulded pharmaceutical or foodstuff by an ink-jet printer.

2. A method according to claim 1, wherein the ink is applied by a vacuum-operated ink-jet printer utilising a piezoelectrically generated shockwave.

3. A method according to claim 1, wherein the ink is applied by a low-pressure ink-jet printer having a nozzle located in an electrical field.

4. A method according to claim 1, wherein the ink is applied by a high-pressure ink-jet printer in which the ink is sprayed from a nozzle under pressure and the spray droplets deflected into a desired pattern by an applied electrical or magnetic field.

5. A method according to claim 2, wherein the ink-jet printer comprises a printing head having a chamber therein in which is located one or more planar piezoelectric oscillators, a supply conduit for feeding the ink to said chamber and a plurality of passageways extending from said chamber and terminating in a plurality of nozzles through which ink droplets are ejected under the influence of said oscillator.

6. A method according to any one of the preceding claims, wherein the moulded pharmaceutical or foodstuff is in tablet form.

7. A method according to claim 6, wherein the tablets are formed by moulding in a die cavity followed by upward ejection of the moulded tablets from the die cavities for subsequent removal by a scraper, wherein the marks are applied to the tablets after moulding but before removal by said scraper.

8. A method according to claim 6, wherein the marks are applied to the tablets as they pass through a printing station on an endless belt or conveyor.

9. A method according to any one of the preceding claims, wherein the ink is a solution or suspension of food colouring agent in water, alcohol or a polyol or a mixture of two or more thereof.

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